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Scyliorhinus tokubee sp. nov. from Izu Peninsula, Southern Japan (Scyliorhinidae, Elasmobranchii)

Shigeru Shirai,[1] Soichi Hagiwara[2] and Kazuhiro Nakaya[1]

[1] Laboratory of Marine Zoology, Faculty of Fisheries, Hokkaido University, 3-1, Minato, Hakodate, 041 Japan
[2] Shimoda Floating Aquarium, 3-22-31, Shimoda, Japan

Abstract A new catshark, *Scyliorhinus tokubee* sp. nov., is described based on specimens from the coast of Shirahama, eastern Izu Peninsula, southern Japan. The present species is distinguished from other congeners in having a particular coloration with dark saddles, blotches and numerous small light spots, a wide oral cleft, the anterior nasal flap not reaching the oral cleft, a short interspace between the dorsal fins, developed clasper hooks, and some meristic characters (number of vertebrae, jaw teeth, and spiral valve turns). This species has been bred under captivity for several years in Shimoda Floating Aquarium.

The catsharks of the genus *Scyliorhinus* are characterized by the presence of a supraorbital crest on the neurocranium, labial furrows restricted to the lower jaw, no barbel on the anterior nasal flap, and the second dorsal fin clearly smaller than the first (Springer, 1979; Compagno, 1984, 1988a). *Scyliorhinus* currently includes 14 valid species with various coloration in the world (Compagno, 1984, 1988b), and *S. torazame* (Tanaka, 1908) has long been known as the only representative of this genus in Japanese waters.

Five years ago, unusual catsharks were captured off the coast of Shirahama, eastern Izu Peninsula, Shizuoka Pref., Japan, from ca. 100 m depth. They have subsequently been exhibited in Shimoda Floating Aquarium, but until now have not undergone taxonomic investigation. The characteristic body coloration with numerous light (yellowish) spots on dorsolateral surface of the body and the large mouth are sufficient to recognize them as a new species. In this paper, we report them as an additional species of the genus *Scyliorhinus*.

Methods for measurements essentially followed Springer (1964). Head length (HL) is the distance from the snout tip to the 5th gill opening. Vertebral counts followed Springer and Garrick (1964), and were taken from radiographs. Jaw teeth were counted in vertical rows. Type specimens of the species described herein have been deposited in HUMZ (Laboratory of Marine Zoology, Faculty of Fisheries, Hokkaido University) and NSMT (National Science Museum, Tokyo).

Scyliorhinus tokubee sp. nov.
(New Japanese name: Izu-hana-torazame)
(Figs. 1–3, Table 1)

Holotype. HUMZ 107358, 413 mm TL, mature male, off Shirahama, Izu Peninsula, Shizuoka Pref., Japan, Feb. 23, 1986.

Paratypes. 1 male and 4 females (all matured), also captured at Shirahama: male—HUMZ 117496, 385 mm TL, Apr. 4, 1990; female—HUMZ 113574, 388 mm TL, HUMZ 113578, 378 mm TL, Apr. 16, 1988; HUMZ 117472, 380 mm TL, May, 1990; NSMT-P 34976, 391 mm TL, Apr. 4, 1990.

Other material. 1 female, preserved in bad condition: HUMZ 111034, ca. 370 mm TL, Shirahama, date unknown.

Diagnosis. A species of *Scyliorhinus* with the following characteristics: (1) dark brownish (bright reddish brown in life) saddles and blotches on dorsolateral surface of body, and numerous small light (yellowish) spots closely distributed on back and sides of body; (2) several spots on sides of body clumped or sometimes merging to form a petal-like pattern; (3) mouth wide, its width 2 times or less in HL; (4) anterior nasal flap not reaching the oral cleft; (5) 1st dorsal fin positioned rather close to 2nd dorsal fin, interdorsal space slightly shorter than mouth width and about equal to distance from snout tip to spiracle; (6) clasper hooks present; (7) monospondylous vertebrae 33–35, precaudal vertebrae 65–68, total vertebrae 108–113; (8) number of teeth (in the entire jaws) 50–53/44–51; (9) number of intestinal valve turns 6; and, (10) maximum body

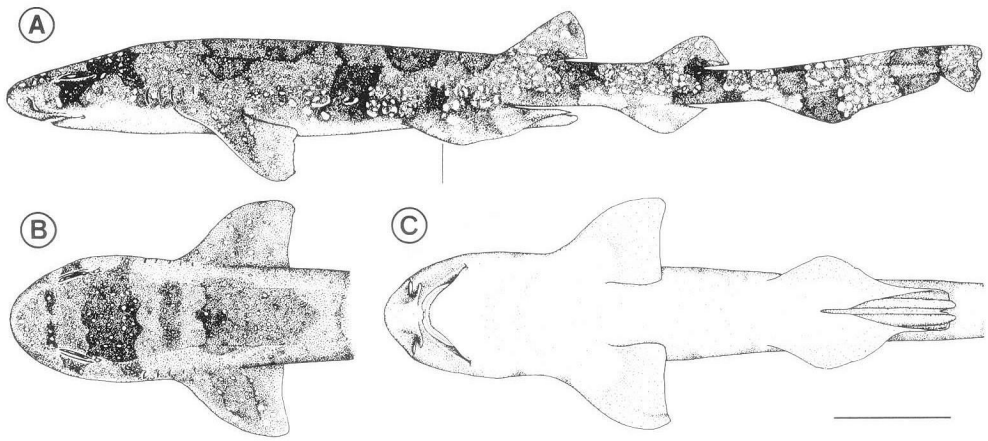

Fig. 1. *Scyliorhinus tokubee* sp. nov., holotype (HUMZ 107358), male, 413 mm TL. A, lateral view; B, dorsal view of head; C, ventral view of head and trunk. Scale bar is 50 mm.

size slightly over 40 cm, and maturing at ca. 35 cm in both sexes.

Description (Table 1). Head moderate in size, well depressed; its length 5.2 (5.1–5.7) in TL, greatest width of head fairly greater than width of trunk. Snout obtuse anteriorly, its length 3.6 (3.4–4.2) in HL, preoral snout 5.3 (4.6–5.8) in HL. Body slender, its width at pectoral axil equal to or slightly greater than depth at same region, gradually tapering and compressed to tail; distance from snout tip to cloaca about 1.2 in that from cloaca to end of caudal fin; no ridges on dorsal-midline, ventral surface of tail, or sides of body; caudal peduncle without any pits and keels, and its height at the posterior end of 2 nd dorsal base slightly greater than its width. First dorsal fin at center of body to caudal end, its origin above posterior end of pelvic fin base or slightly ahead of it; 1st dorsal fin with almost straight anterior margin, round apex, not falcate posterior margin, and angular posterior corner; its height 1.4 (1.2–1.6) in base of 1st dorsal fin. Interdorsal space shorter than mouth width. Second dorsal fin with bluntly pointed rear tip, originating at about level with middle of anal fin base; its height and base length 1.7 (1.5–1.7) and 1.4 (1.2–1.5) times in those of 1st dorsal fin, respectively. Pectoral fin somewhat large, broad, with long, broadly convex anterior margin, almost straight posterior and inner margins, and rectangular inner corner; its length of anterior margin 1.4 (1.1–1.4) in HL. Pelvic fin broad, with rounded outer corner; inner margin fused with the opposite one; in males, pelvic fin elongated posteriorly, covering claspers. Clasper in mature males cylindrical, not greatly tapered, extending slightly behind free rear tips of pelvic fin; hypopyle elongated, margined by developed rhipidion and exorhipidion, which are covered with dense squamation; a series of clasper hooks present along inside exorhipidion; pseudosiphon absent. Caudal fin with moderately developed lower lobe and distinct subterminal notch; upper caudal lobe originating as a low ridge below the free rear margin of 2nd dorsal base; lower caudal lobe arising behind origin of upper lobe by a distance equal to or greater than eye diameter.

Nostril large, separated from the opposite one by a vertical length of 2nd gill opening; incurrent aperture large and elongated, positioned in middle of snout; excurrent aperture and small posterior nasal flap covered by a large, bluntly pointed anterior nasal flap; anterior nasal flap not reaching oral cleft, with no incipient barbel-like ridge. Eye dorsolateral on head, spindle-shaped; eye diameter 2 times internasal space. Mouth large, broadly arched; anterior tip of lower jaw below the anterior end of eye; mouth width 2 in HL; labial furrow present only on lower jaw, its length less than half that of 2nd gill opening. Spiracle small, a little behind orbit and slightly below a level through horizontal axis of eye; interspace between posterior end of eye and spiracle (point to point) equal to the vertical length of spiracle. Gill openings vertical, moderate in size; 1st opening largest, smaller to the 5th; length of 1st opening about 1.5 in eye diameter, that of 5th opening 2 in the 1st; 4th and 5th gill openings on base of pectoral fin.

Table 1. Proportional measurements in percentage of TL and counts of type specimens of *Scyliorhinus tokubee* sp. nov. (measurements in millimeters are given for holotype).

	Holotype		Paratypes	
Sex	male		1 male	4 females
Total length (mm)	413		385	378–391
	mm	% TL	% TL	% TL
Snout tip to:				
eye	23	5.4	4.9	4.2– 5.3
mouth	15	3.6	3.4	3.3– 4.0
spiracle	39	9.4	9.0	4.5– 9.0
1st gill-opening	58	14.0	13.8	12.3–13.8
pectoral origin	70	16.9	16.9	14.7–16.7
5th gill-opening (HL)	79	19.1	19.5	17.5–18.4
pelvic origin	165	40.0	40.0	40.7–42.1
1st dorsal origin	206	49.9	48.8	48.3–51.6
anal origin	253	61.3	60.5	58.4–60.3
2nd dorsal origin	272	65.9	66.0	63.9–66.9
upper caudal origin	302	73.1	72.5	70.5–74.6
lower caudal origin	323	78.2	75.6	73.8–77.5
Interspace between:				
pectoral and pelvic bases	67	16.2	16.9	19.2–19.9
pelvic and anal bases	45	10.9	9.1	8.6–10.3
anal base and lower caudal origin	37	8.8	6.4	7.4– 8.7
1st and 2nd dorsals	34	8.2	8.8	8.1– 8.7
Nostrils:				
distance between inner corners	8	1.9	1.8	1.7– 1.9
Mouth:				
width	39	9.4	9.4	8.6– 9.7
Gill opening length (1st)	10	2.4	2.1	2.1– 2.3
Eye diameter	14	3.4	3.1	3.2– 4.0
1st dorsal fin:				
length of base	31	7.4	8.2	6.9– 7.7
height	22	5.2	5.1	5.4– 6.2
2nd dorsal fin:				
length of base	23	5.4	5.3	5.3– 6.2
height	13	3.0	3.1	3.3– 3.9
Pectoral fin:				
length of anterior margin	56	13.6	13.8	13.9–15.3
length of base	28	6.8	7.1	6.4– 7.1
Pelvic fin:				
fin length	74	17.9	20.1	11.6–13.0
length of base	44	10.5	11.4	9.5–10.8
Anal fin:				
length of base	35	8.5	8.6	7.9– 8.2
height	13	3.0	3.2	3.2– 3.8
Caudal fin:				
upper caudal lobe	111	26.9	27.5	25.9–27.1
Number of teeth:				
upper	52		50	46– 53
lower	48		48	44– 53
Number of vertebrae:				
monospondylous	34		34	33– 34
precaudal	66		66	66– 68
total	108		112	109–113
Number of intestinal valve turns	6		6	6

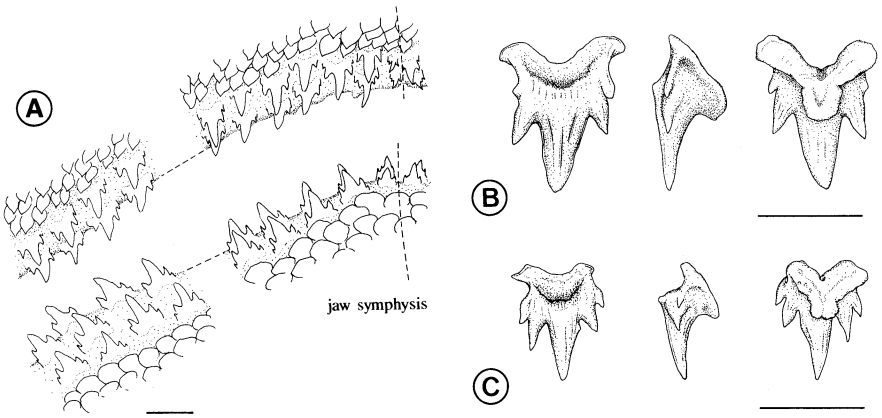

Fig. 2. Jaw teeth of *Scyliorhinus tokubee*, sp. nov. A, lateral view of right jaw dentition and dermal denticles of paratype (HUMZ 117472), female, 380 mm TL; B and C, labial (left), lateral (middle), and lingual views (right) of 5th anterolateral upper tooth of male (B, holotype, 413 mm TL) and female (C, paratype, 391 mm TL, NSMT-P 34976). Scale bars are 1.0 mm.

Jaw teeth moderate in size, similar in shape throughout on both jaws and along jaws (Fig. 2A); 1 or 2 small teeth on symphysis of both jaws; 2 or 3 tooth series functional; tooth formula of holotype 25–1–1–25/23–1–1–23, number of teeth in paratypes 50–53/44–51. Each tooth (Fig. 2B, C) on broad, bifid root, with an erect and sharply pointed median cusp and 2 pairs of minute lateral cusps; upper teeth with somewhat larger cusps than lower.

Dermal denticles (Fig. 3A, B) on back and sides of body flat, leaf-like, with a long central cusp and a pair of minute lateral cusps; medial ridge of crown weak, but extending the entire length of the crown; dermal denticles on nape (Fig. 3C, D), dorsum and anterolateral surface of trunk moderately erect, some with an enlarged, higher cusp distributed irregularly; dermal denticles on sides of body and tail gradually inclined to caudal fin, more closely distributed, without a distinct medial ridge and lateral cusps on crown. Ventral dermal denticles raindrop-shaped without a medial ridge and lateral cusps, strongly inclined, slightly overlapping with neighbors to form a robust, pavement-like body surface; anterior edge of oral cleft fringed by central cusps of dermal denticles (Fig. 2A). Whole body and fins covered with denticles except at axil of pelvic fin and its inner surface covering clasper.

Monospondylous vertebrae 34 (33–34), precaudal vertebrae 66 (66–68), total vertebrae 108 (109–113). Number of intestinal valve turns 6.

Coloration. Body grayish brown above, pale cream yellow to white below, with dark brown (bright reddish brown in life) saddles and blotches; blotches on precaudal expanded to ventral surface of body; seven wide saddles on interorbital region, above pectoral fin, in front of pelvic fin, on 1st and 2nd dorsal fin bases and caudal fin, and in front of subterminal notch; 7 distinct blotches below eye, on pectoral fin base, middle portion of trunk, pelvic fin base, below 1st and 2nd dorsal fins, lower caudal lobe, and in front of subterminal notch; numerous white spots (lustrous yellow or golden in life) closely scattered on dorsolateral surface of body; light or white spots on back about equal to or slightly larger than size of eye pupil; several spots on sides of body irregularly clumped (sometimes merged) to form a pattern of a petal of the cherry blossom. Dorsal fins, caudal fin, dorsal surface of pectoral and pelvic fins grayish brown with white spots; anal fin with pale but distinct blotches on whitish background; ventral surfaces of paired fins same as ventral surface of body without any blotches or spots. No dark spots on body and fins.

Sexual dimorphism. Heterodonty by sex is apparent, but weak. Adult male specimens have somewhat larger teeth on both jaws, which are characterized by stout median and 1st lateral cusps and vestigial 2nd lateral cusps (Fig. 2B). Pelvic fins in males have very elongated free rear margin. The body cavity is much longer in females than in males (Table 1).

Distribution. *Scyliorhinus tokubee* was recorded

from the coast of Shirahama, Izu Peninsula, Japan; *S. torazame* has not been captured in this region. All the specimens were captured in gill nets set for flounders or by bottom lines, in ca. 100 m deep.

Biological notes. The second author has bred the present species for five years in Shimoda Floating Aquarium, Fujita Tourist Enterprises Co., Ltd., offsprings born in the tank having already reached maturity. Young specimens have similar coloration to adults, although more distinct saddles and blotches. *Scyliorhinus tokubee* is an oviparous species. The egg capsule is grayish brown and is about 45 mm long, with elongated, coiled tendrils. Two females paratypes have a capsule with an egg in each oviduct, suggesting that *S. tokubee* is a single oviparous species in the sense of Nakaya (1975).

Etymology. From the name of the fishing boat and private lodge of Mr. Toshiyuki Iida who captured and presented all of the type specimens to Shimoda Floating Aquarium, and who is familiarly called "Tokubee-san". "Tokubee" is an old-fashioned male name in Japan.

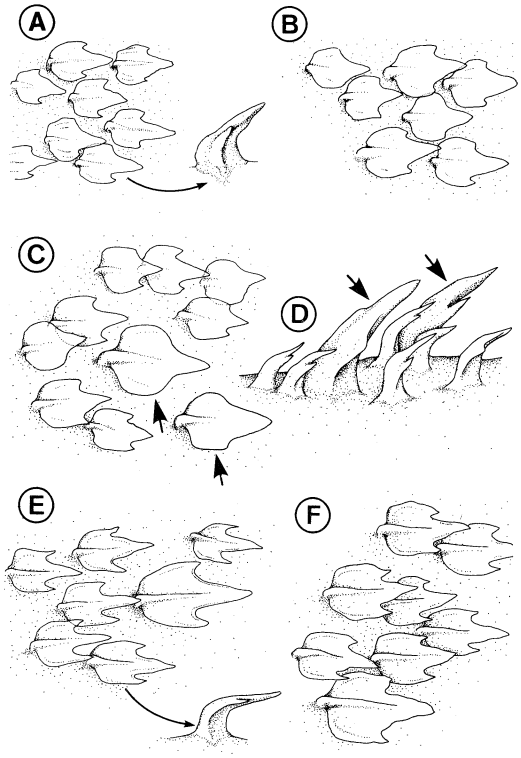

Fig. 3. Dermal denticles of *Scyliorhinus* species. A–D, *S. tokubee*, sp. nov., holotype (HUMZ 107358), male, 413 mm TL; E and F, *S. torazame*, HUMZ 117842, male, 399 mm TL. A and E, on side of trunk above pectoral fin base (dorsal views), with a lateral view; B and F, on side of trunk below 1st dorsal fin origin (dorsal view); C, on nape (dorsal view), showing an enlarged denticle (arrow); D, ventral view of C. Scale bar is 0.5 mm.

Comparison

The genus *Scyliorhinus* includes 14 species, each with a distinctive coloration, which is effective for identification of species (Springer, 1966, 1979; Compagno, 1984, 1988a, b). The present new species, *S. tokubee*, has a series of dark saddle-marks and blotches with numerous light spots (no blackish spots) scattered on the body. Other species of *Scyliorhinus* with light spots on the body are: *S. capensis* (Smith, 1838) from South Africa, *S. torazame* (Tanaka, 1908) from Japan, Korea, China, and the Philippines, *S. torrei* Howell-Rivero, 1936, from Florida, Bahamas, and Cuba, *S. hesperius* Springer, 1966, from Honduras and Colombia, western Atlantic, and *S. comoroensis* Compagno, 1988b, from the Comoro Is., western Indian Ocean.

In color pattern, *Scyliorhinus tokubee* is distinguishable from these five congeners in having smaller and much lighter spots. The light spots on the lateral surface of the body in *S. tokubee* are so closely distributed that they fuse with neighboring ones to form a larger marking, which may resemble a petal of cherry blossoms. *Scyliorhinus comoroensis* also has numerous, minute white spots, but these are more sparsely and uniformly distributed than those of *S. tokubee*, and do not form a particular pattern (Compagno, 1988b). The white spots of the other four species are somewhat larger, more sparsely distributed, or obscure (Tanaka, 1908; Bigelow and Schroeder, 1948; Springer, 1966, 1979; Compagno, 1984, 1988b).

Scyliorhinus tokubee differs distinctly from the five aforementioned species, in its wide oral cleft and short interspace between the dorsal fins (Table 2); the mouth width is 2.0 times or less in HL in *S. tokubee*, compared with 2.2 times or more in the other five species, and the interdorsal space of *S. tokubee* is the shortest of the six species. In *S. tokubee*, the interdorsal space is slightly shorter than the mouth width (rather longer than the mouth width in other species), and is about equal to the distance from the

snout tip to the spiracle (longer than the distance in *S. capensis*, *S. torazame*, and *S. torrei*). These measurements are highly diagnostic for *S. tokubee*.

Scyliorhinus comoroensis was described based on one mature male specimen (Compagno, 1988b). It has a large, anterior nasal flap reaching the oral cleft, with a distinct middle ridge (the flap does not reach the oral cleft and lacks a middle ridge in *S. tokubee*). It also has a higher number of vertebrae and intestinal valve turns than *S. tokubee* (Table 3).

In proportional dimensions, *Scyliorhinus tokubee* is very similar to *S. hesperius*. However, *S. hesperius* has a higher number of vertebrae and intestinal valve turns than the former (Table 3). Meristic counts also distinguish *S. tokubee* from *S. capensis*, the latter having more vertebrae, intestinal valve turns, and jaw teeth (Table 3).

Scyliorhinus torrei has similar counts of vertebrae and intestinal valve turns as *S. tokubee*, but is distinctly different in body proportions (Bigelow and Schroeder, 1948; Springer, 1966, 1979; Campagno, 1984). In particular, the interdorsal space of *S. torrei* is considerably longer than that of *S. tokubee*, and the 2nd dorsal fin originates above the posterior end of the anal fin base (compared with the middle of the anal fin base in *S. tokubee*). *Scyliorhinus torrei* has an elongated labial furrow on the lower jaw, equal to the length of the 2nd gill opening (Bigelow and Schroeder, 1948; less than half the length of the 2nd gill opening length in *S. tokubee*), and it lacks specialized clasper hooks on the exorhipidion (Compagno, 1988b; present in *S. tokubee*).

Scyliorhinus tokubee is clearly distinguishable from *S. torazame*, also distributed in Japan, by both mouth width and length of interdorsal space, as discussed above. The color pattern of the two species is also distinctly different; *S. torazame* has somewhat variable coloration, sometimes showing a petal-like pat-

Table 2. Selected measurements of 6 *Scyliorhinus* species.

Species	Mouth width % TL (times in HL)	Interdorsal space % TL	Citation *
S. tokubee	8.6–9.7 (1.9–2.0)	8.1–8.7	6)
S. capensis	7.3, 8.1 (2.7, ?)	11.3, 11.0	2), 4)
S. comoroensis	6.9 (2.7)	10.3	5)
S. hesperius	7.0–7.5 (2.5–2.7)	9.2–10.7	4)
S. torazame	7.6–8.2 (2.2–2.4)	9.7–11.8	3), 6)
S. torrei	6.6–7.8 (2.2–2.7)	10.9–14.5	1), 4)

*1 Bigelow and Schroeder (1948), *2 Bass et al. (1975), *3 Nakaya (1975), *4 Springer (1979), *5 Compagno (1988b), *6 this study.

Table 3. Counts of monospondylous (MS), precaudal (PC), and total (TC) vertebrae, jaw teeth, and intestinal valve turns of 6 *Scyliorhinus* species.

Species	Number of vertebrae			Tooth counts	Intestinal valve turns	Citation *
	MS	PC	TC			
S. tokubee	33–35	65–68	108–113	50–53/44–51	6	6)
S. capensis	44–46	91–95	130–144	65–70/55–65	10–11	2), 5)
S. comoroensis	40	91	137	50/50	8	5)
S. hesperius	39–42	–	122–130	48–52/45–46	8	1), 4), 5)
S. torazame	33–38	69–73	107–111	40–46/38–42	7	3), 6)
S. torrei	30–34	–	114–123	40–46/38–43	6–7	1), 4), 5)

*1 Springer (1966), *2 Bass et al. (1975), *3 Nakaya (1975), *4 Springer (1979), *5 Compagno (1988b), *6 this study.

tern on the lateral surface of the body, but it lacks numerous light spots on the dorsal surface. These two species can also be distinguished by the number of jaw teeth (Table 3) and size of the dermal denticles on the body. On the sides of the trunk, the dermal denticles of *S. tokubee* (Fig. 3A, B) are smaller, with reduced lateral cusps, and more erect than those of *S. torazame* (Fig. 3E, F). Thus, the body surface of *S. tokubee* has a relatively rough appearance.

In captivity, the new species attains at least slightly over 40 cm and matures at ca. 35 cm TL in both sexes. *Scyliorhinus capensis* is a very large species, reaching 122 cm (Compagno, 1984), and *S. comoroensis* (known from only one specimen of 466 mm TL; Compagno, 1988b), *S. hesperius* (maximum TL at least 47 cm: Compagno, 1984), and *S. torazame* (slightly over 50 cm TL; Nakaya, 1975) are also slightly larger than *S. tokubee*. On the contrary, *S. torrei* reaches 32 cm TL or less (Springer, 1979), distinctly smaller than *S. tokubee*.

Comparative materials

Scyliorhinus torazame. 4 males and 4 females: male—HUMZ 110913, 462 mm TL, 110915, 462 mm TL, HUMZ 117842, 399 mm TL, off Hakodate, Hokkaido; HUMZ 111033, 346 mm TL, off Mito, Ibaraki; female—HUMZ 76081, 412 mm TL, off Hakodate; HUMZ 95139, 309 mm TL, 250 km west of Okinawa Is.; HUMZ 113579, 423 mm TL, off Mito, Ibaraki; uncatalogued, 439 mm TL, off Kashiwazaki, Niigata.

Acknowledgments

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伊豆白浜沖で採集されたトラザメ属の1新種イズハナトラザメ

白井　滋・萩原宗一・仲谷一宏

静岡県下田市白浜沖で採集されたトラザメ属の1新種，イズハナトラザメ (*Scyliorhinus tokubee*) を成熟した6個体に基づいて記載した．本種は体の背側面に7列の暗褐色横縞と多数の小白色斑（生時には，黄色または金色）が散在し，体側面の小斑点が集合して花弁状の斑紋をなすこと，頭部が縦偏し，口裂幅が広く頭長の1/2ないし，それ以上であること，前鼻弁が口裂に達し

ないこと，背鰭間の距離が口裂幅よりもいくぶん短く，吻端から噴水孔までの距離にほぼ等しいこと，交接器に1列の鉤状鱗をもつこと，monospondylous vertebrae が33–35，両顎の歯が50–53/44–51，また，腸の螺旋弁の巻数が6であることにより同属の他種と区別される．本種は5年間にわたって藤田観光（株）下田海中水族館において飼育環境下で繁殖し，水槽内で2世代目の個体が成熟に達している．

（白井・仲谷：041 函館市港町3–1　北海道大学水産学部水産動物学講座；萩原：451 下田市3–22–31　藤田観光（株）下田海中水族館）